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(54) **BALL JOINT LINK AND METHOD OF PRODUCING SAME**

KUGELGELENK UND VERFAHREN ZUR HERSTELLUNG

LIAISON A ROTULE ET SON PROCEDE DE PRODUCTION

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- **PATENT ABSTRACTS OF JAPAN vol. 8, no. 166 (M-314), 2 August 1984 & JP 59 062722 A (OILES KOGYO), 10 April 1984,**

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Description

BACKGROUND OF THE INVENTION

[0001] This invention relates to improved ball joint links that are light in weight and inexpensive to manufacture.

[0002] Molding techniques in the past have been used in the fabrication of various ball joint components. For example, Duncan U.S. Patent No. 3,941,495 teaches a method for forming a ball around a stud to form a ball stud.

[0003] Sinclair U.S. Patent No. 5,277,860 discloses an all-plastic rod end in which opposed raceways are mated to form a socket around a ball. The raceways are then overmolded to complete fabrication of the rod end.

[0004] Membry U.S. Patent 3,591,669 discloses a plastic universal bearing which is molded in place in a link. In this case, the plastic that forms the socket of the ball joint is integral with the plastic that forms the center section of the link.

[0005] Hellon U.S. Patent Application Serial No. 08/253,688, filed June 3, 1994 and assigned to the assignee of the present invention (EP-A-0 690 242), discloses an insert molded ball joint as shown in attached Figure 8. The ball joint of Hellon includes a housing 100 which is insert molded around three separate parts: a tubular center section 102 of a ball joint link, a ball 104 of a ball stud 106, and a cap 108. A high-strength, fiber-reinforced plastic is used for the housing 100, and the same high-strength material that forms the housing 100 both secures the housing 100 to the center section 102 and forms the bearing surface for the ball 104. In this way, high pull out forces are required to dislodge the ball stud 106 from the housing 100.

[0006] The present invention differs significantly from the prior art of Figure 8, particularly with respect to the manner in which the ball stud is retained in the ball joint, the manner in which the ball joint socket is formed, and the manner in which the ball joint is molded.

SUMMARY OF THE INVENTION

[0007] According to the present invention, there is provided a ball joint link comprising a ball stud comprising a stud which supports a ball; a molded body formed around at least a portion of the ball to form a ball joint characterised in that a strengthening element is disposed around the ball stud, said strengthening element comprising a first portion receiving at least part of the ball and a second portion extending radially inwardly from the first portion, said molded body being around at least a portion of the first portion of the strengthening element to hold the ball in the ball joint, and said first portion of the strengthening element being at least partially molded in place and embedded in the molded body.

[0008] The embodiments of this invention are preferably used together, as described in the following detailed description. However, it should be understood that each embodiment of this invention can be used independently of one another if desired.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figure 1 is a side elevational view of a ball joint link which incorporates a preferred embodiment of this invention.

[0010] Figure 2 is a cross-sectional view of the ball joint link of Figure 1.

[0011] Figure 3 is a perspective view of a strengthening element shown in Figure 2.

[0012] Figure 4 is a side view of the strengthening element of Figure 3.

[0013] Figure 5 is a cross-sectional view taken along line 5-5 of Figure 4.

[0014] Figure 6 is a perspective view of a ball cap shown in Figure 2.

[0015] Figure 7 is a cross-sectional view taken along line 7-7 of Figure 1, showing portions of a mold used to form the body 12.

[0016] Figure 8 is a cross-sectional view of a prior art ball joint.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] Turning now to the drawings, Figures 1 and 2 show two views of a ball joint link 10 which comprises a body 12 that forms two ball joints 14, 16. In the Figures, the ball joints 14, 16 are oriented at right angles to one another. It should be understood that in general the ball joint link 10 can include one or more ball joints, and if multiple ball joints are provided, they can be oriented at any desired angle with respect to one another. For example, many ball joint links include two ball joints oriented with an included angle of 180° between the ball joints. The ball joint link 10 can, for example, be adapted for use with automotive suspension components, such as stabilizer bar links.

[0018] The ball joint 14 includes a ball stud 18 that includes a threaded stud 20 and a ball 22. Many arrangements are possible for the ball stud 18. For example, the ball 22 can be formed integrally with the stud 20, or the ball 22 can be molded in place on the stud 20. In this embodiment, the ball 22 defines a non-spherical surface 24 that forms a recess within the ball 22. Alternately, the end of the ball 22 opposite the stud 20 can be spherical in shape.

[0019] The ball 22 is surrounded by a strengthening element 26, which is shown in greater detail in Figures 3 through 5. The strengthening element 26 is a reinforcing element formed of a high-strength material such as a suitable steel. The strengthening element 26 includes a first portion 28 shaped as an annular flange that defines an array of through holes 30. The strengthening

element 26 also includes a second portion 32 that extends radially inwardly from the first portion 28, and that defines an annular surface 34 shaped and positioned to bear on the ball 22. As best shown in Figure 2, the diameter of the bearing surface 34 can be smaller than the diameter of the ball 22, such that the ball 22 is prevented from passing through the strengthening element 26. Alternately, the annular surface can be sized to allow the ball 22 to pass through the strengthening element 26.

[0020] As shown in Figures 2 and 6, a ball cap 36 is pivotably mounted on the ball 22. The ball cap 36 defines a bearing surface 38 that receives the ball 22. The bearing surface 38 forms a ball-receiving recess that defines a solid angle of at least about a hemisphere. As shown in Figure 2, the bearing surface 38 extends more than half way around the ball 22, and the ball cap 36 is held in place on the ball 22 with a snap fit. If desired, slits 40 (Figure 6) can be formed on the ball cap 36 to facilitate assembly of the ball cap 36 on the ball 22. The ball cap 36 can include an integral protrusion 39.

[0021] As best shown in Figure 2, the ball cap 36 cooperates with the ball 22 to form a confined space 42 therebetween. This space 42 can be partially filled with a lubricant such as a suitable grease.

[0022] The ball joint 16 is similar to the ball joint 14 described above, except that the ball joint 16 does not include a strengthening element. In the illustrated embodiment, both of the ball joints 14, 16 are formed in a single insert molding operation.

[0023] As best shown in Figure 2, each of the ball joints 14, 16 includes an elastomeric boot 46 and a threaded nut 48 received on the respective stud. Each of the boots 46 is secured to the housing 12 by a retaining ring 50 and to the respective nut 48 by a retaining ring 52. In the conventional manner, the region enclosed by the boot 46 can contain a lubricant such as a suitable grease.

[0024] The ball joint link 10 can be formed efficiently in an insert molding operation. First the ball studs are lubricated with a suitable grease that is held in place by the respective ball caps 36. The ball caps 36 snap in place on the respective balls, thereby retaining the grease in place and preventing plastic from entering the recess in the ball during the subsequent molding operation. Then the balls, the ball caps and the strengthening element 26 are positioned properly inside a mold cavity. Fixtures (not shown in Figure 2) preferably position the strengthening element 26 into contact with the ball 22, as shown in Figure 2. Alternately, the strengthening element 26 can be positioned by causing it to bear against the ball cap 36 or the mold surface.

[0025] As shown in Figure 7, a mold 60 is used to form the body 12. This mold 60 comprises two protrusions 62 that are positioned to contact the ball cap 36. These protrusions 62 perform two functions: they form a stop for the ball stud/cap combination to locate this combination properly in the mold; and they prevent the ball cap 36 from moving away from the ball 22 (Figure 2). In the preferred embodiment, the protrusion 39 of the ball cap 36 is captured between the protrusions 62 of the mold 60, thereby preventing undesired rotation of the ball cap 36 on the ball 22 during the molding operation. After the mold cavity is closed, thermoplastic material is injected into the mold cavity. This thermoplastic material substantially embeds the ball cap 36, and it fills the through holes 30 and the space on both sides of the first portion 28 in order to anchor the strengthening element 26 securely in place in the body 12.

[0026] Preferably, the thermoplastic material is a fiber-reinforced material, and the flow of thermoplastic material in the mold is arranged to enhance the strength of the resulting body 12. In this example, the thermoplastic material is injected into the mold near point E, and the mold is vented at various points V (Figure 2). This tends to align the fibers in the thermoplastic material in a high-strength orientation. After the thermoplastic material has cooled the mold is opened and the remaining components of the ball joint link 10 are assembled. The protrusions 62 of the mold 60 leave indentations in the body 12 that extend laterally with respect to the stud 20 (Figure 2).

[0027] Alternately, the ball cap 36 may be held in position by rods that extend laterally into the mold cavity (either transverse or at a predetermined angle to the axis of the stud). These rods (not shown) perform the same function as the protrusions 62, but they can be removed from the mold cavity during the molding operation to prevent the formation of indentations in the body 12.

[0028] Materials, dimensions, and details of construction can, of course, be varied to fit the specific application. The following details of construction are provided merely to define the presently preferred embodiment in greater detail, and are not intended to be limiting. The body 12 can be formed of a thermoplastic such as 30% glass reinforced 6/6 nylon. DuPont 70G33 has been found suitable. The strengthening element 26 can be formed of a material such as 1020 steel, having a wall thickness of about 0.090 inches. The ball caps 36 can be formed of an acetal material such as that sold under the tradename Delrin. The ball studs can be formed of 4140 steel, and the nuts and retaining rings can also be formed of suitable steel. The boots can be formed of urethane or rubber.

[0029] The ball joint link described above provides a number of important advantages. First, the strengthening element is securely anchored in the body, and the considerable hoop strength of the strengthening element provides a substantial increase in the strength of the ball joint link to resist pull out forces exerted in the direction P. High pull out force resistance is provided while allowing the use of a ball cap formed of a material that provides an excellent bearing surface, and while accommodating a wide angular range of motion for the ball stud.

[0030] Additionally, since the body 12 is insert molded

around the major components of the ball joint, the assembly is light in weight and relatively inexpensive to manufacture. Since the end caps snap in place on the balls of the ball studs, the end caps are effectively retained in position on the balls during the molding operation.

[0031] In the intended application for the ball joint link 10, pull out forces along the direction P are anticipated to be substantially greater than pull out forces in the direction Q. For this reason, the ball joint 14 does not require a strengthening element 26 in this application. Of course, it will be understood that strengthening elements 26 can be provided on all of the ball joints of the ball joint link 10 if desired.

[0032] A wide range of changes and modifications can be made to the preferred embodiments described above. For example, the strengthening element 26 described above can be used without the ball cap 36. Additionally, materials and configurations can be adapted as appropriate for the particular application. Furthermore, it is not required that the first portion of the strengthening element be annular in configuration.

[0033] It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting. It is the following claims, including all equivalents, which define the scope of this invention.

Claims

1. A ball joint link (10) comprising:

   a ball stud (18) comprising a stud (20) which supports a ball (22);
   a molded body (12) formed around at least a portion of the ball to form a ball joint **characterised in that** a strengthening element (26) is disposed around the ball stud (18), said strengthening element (26) comprising a first portion (28) receiving at least part of the ball (22) and a second portion (32) extending radially inwardly from the first portion (28), said molded body (12) being formed around at least a portion of the first portion (28) of the strengthening element (26) to hold the ball (22) in the ball joint, and said first portion (28) of the strengthening element (26) being at least partially molded in place and embedded in the molded body (12).

2. The ball joint link (10) of Claim 1 wherein the second portion (32) receives the stud (20) but prevents the ball (22) from passing therethrough.

3. The ball joint link (10) of either of Claim 1 or Claim 2 wherein the second portion (32) of the strengthening element (26) comprises an annular surface (34) positioned to bear against the ball (22).

4. The ball joint link (10) of any preceding Claim wherein the first portion (28) of the strengthening element (26) comprises an annular flange insert molded in the body (12).

5. The ball joint link (10) of Claim 4 wherein the annular flange (28) comprises a plurality of through holes (30), wherein the body (12) comprises a thermoplastic material, and wherein the thermoplastic material extends into the through holes (30) to anchor the strengthening element (26) in the body (12).

6. The ball joint link (10) of any preceding Claim further comprising a cap (36) mounted on the ball (22) and insert molded in the body (12).

7. The ball joint link (10) of Claim 6 wherein the cap (36) defines a ball-receiving recess, and wherein the recess extends over a solid angle of at least about a hemisphere, thereby forming a bearing surface (38) for the ball (22).

8. The ball joint link (10) of either of Claim 6 or Claim 7 wherein the cap (36) encloses a space (42) adjacent the ball (22), and wherein a lubricant is disposed in the space (42).

9. The ball joint link (10) of any of Claims 6 to 8 wherein the cap (36) is substantially completely embedded in the body (12).

10. The ball joint link (10) of Claim 6 wherein the cap (36) defines a ball-receiving recess, and wherein the recess receives the ball (22) in a snap fit that retains the cap (36) on the ball (22).

11. The ball joint link (10) of any preceding Claim wherein the body (12) is secured to an additional element.

12. The ball joint link (10) of Claim 11 wherein the additional element comprises an additional ball stud.

Patentansprüche

1. Kugelgelenkverbindung (10), welche umfasst:

   einen Kugelbolzen (18), der einen Bolzen (20), welcher eine Kugel (22) trägt, umfasst;

   einen gegossenen Grundkörper (12), der um mindestens einen Bereich der Kugel ausgebildet ist, um ein Kugelgelenk zu bilden, **dadurch gekennzeichnet, dass** ein Verstärkungselement (26) um den Kugelbolzen (18) herum angeordnet ist, wobei das Verstärkungselement (26) einen ersten Bereich (28) umfasst, der

mindestens einen Teil der Kugel (22) aufnimmt, und einen zweiten Bereich (32) umfasst, der sich radial einwärts von dem ersten Bereich (28) erstreckt, wobei der gegossene Grundkörper (12) um mindestens einen Bereich des ersten Bereichs (28) des Verstärkungselements (26) herum ausgebildet ist, um die Kugel (22) in dem Kugelgelenk zu halten, und wobei der erste Bereich (28) des Verstärkungselements (26) mindestens teilweise an der Verwendungsstelle eingegossen und in dem gegossenen Grundkörper (12) eingebettet ist.

2. Kugelgelenkverbindung (10) nach Anspruch 1, wobei der zweite Bereich (32) den Bolzen (20) aufnimmt, aber verhindert, dass die Kugel (22) hindurchfällt.

3. Kugelgelenkverbindung (10) nach Anspruch 1 oder 2, wobei der zweite Bereich (32) des Verstärkungselements (26) eine ringförmige Fläche (34) umfasst, die dazu positioniert ist, gegen die Kugel (22) zu drücken.

4. Kugelgelenkverbindung (10) nach einem der vorhergehenden Ansprüche, wobei der erste Bereich (28) des Verstärkungselements (26) einen ringförmigen Flansch umfasst, der in den Grundkörper (12) eingegossen ist.

5. Kugelgelenkverbindung (10) nach Anspruch 4, wobei der ringförmige Flansch (28) eine Vielzahl von Durchgangslöchern (30) umfasst, wobei der Grundkörper (12) ein thermoplastisches Material umfasst, und wobei sich das thermoplastische Material in die Durchgangslöcher (30) erstreckt, um das Verstärkungselement (26) in dem Grundkörper (12) zu verankern.

6. Kugelgelenkverbindung (10) nach einem der vorhergehenden Ansprüche, der außerdem eine Kappe (36) umfasst, die auf der Kugel (22) montiert ist und in den Grundkörper (12) eingegossen ist.

7. Kugelgelenkverbindung (10) nach Anspruch 6, wobei die Kappe (36) eine Kugelaufnahmeaussparung begrenzt, wobei die Aussparung sich über einen Raumwinkel von mindestens etwa einer halben Kugel erstreckt, um dadurch eine Lagerfläche (38) für die Kugel (22) zu bilden.

8. Kugelgelenkverbindung (10) nach Anspruch 6 oder 7, wobei die Kappe (36) einen Raum (42) benachbart zu der Kugel (22) einschließt, und wobei ein Schmiermittel in dem Raum (42) angeordnet ist.

9. Kugelgelenkverbindung (10) nach einem der Ansprüche 6 bis 8, wobei die Kappe (36) im wesentlichen vollständig in dem Grundkörper (12) eingebettet ist.

10. Kugelgelenkverbindung (10) nach Anspruch 10, wobei die Kappe (36) einen Kugelaufnahmeaussparung begrenzt und wobei die Aussparung die Kugel (22) in einem Schnappverschluss aufnimmt, der die Kappe (36) auf der Kugel (22) zurückhält.

11. Kugelgelenkverbindung (10) nach einem der vorhergehenden Ansprüche, wobei der Grundkörper (12) mit einem Zusatzelement verbunden ist.

12. kugelgelenkverbindung (10) nach Anspruch 11, wobei das Zusatzelement einen zusätzlichen Kugelbolzen umfasst.

Revendications

1. Lien d'articulation à rotule (10) comprenant :

un goujon de rotule (18) comprenant un goujon (20) qui soutient une rotule (22) ;
un corps moulé (12) formé autour d'au moins une partie de la rotule pour former une articulation à rotule **caractérisé en ce qu'**un élément de renfort (26) est agencé autour du goujon de rotule (18), ledit élément de renfort (26) comprend une première partie (28) recevant au moins une partie de la rotule (22) et une seconde partie (32) qui s'étend de façon radiale vers l'intérieur de la première partie (28), ledit corps moulé (12) étant formé autour d'au moins une partie de la première partie (28) de l'élément de renfort (26) pour maintenir la rotule (22) dans l'articulation à rotulc, et ladite première partie (28) de l'élément de renfort (26) étant au moins moulée partiellement en place et encastrée dans le corps moulé (12).

2. Lien d'articulation à rotule (10) selon la revendication 1, dans lequel la seconde partie (32) reçoit le goujon (20) mais empêche la rotule (22) de passer à travers celui-ci.

3. Lien d'articulation à rotule (10) selon la revendication 1 ou la revendication 2, dans lequel la seconde partie (32) de l'élément de renfort (26) comprend une surface annulaire (34) positionnée de façon à appuyer contre la rotule (22).

4. Lien d'articulation à rotule (10) selon l'une quelconque des revendications précédentes, dans lequel la première partie (28) de l'élément de renfort (26) comprend un collet annulaire inséré moulé dans le corps (12).

5. Lien d'articulation à rotule (10) selon la revendication 4, dans lequel le collet annulaire (28) comprend une pluralité de trous traversants (30), dans lequel le corps (12) comprend un matériau thermoplastique, et dans lequel le matériau thermoplastique s'étend dans les trous traversants (30) pour s'ancrer sur l'élément de renfort (26) dans le corps (12).

6. Lien d'articulation à rotule (10) selon l'une quelconque des revendications précédentes, comprenant en outre un bouchon (36) monté sur la rotule (22) et inséré moulé dans le corps (12).

7. Lien d'articulation à rotule (10) selon la revendication 6, dans lequel le bouchon (36) définit un renfoncement pour recevoir la rotule, et dans lequel le renfoncement s'étend sur un angle solide d'au moins un hémisphère environ, formant de ce fait une surface de support (38) pour la rotule (22).

8. Lien d'articulation à rotule (10) selon la revendication 6 ou la revendication 7, dans lequel le bouchon (36) entoure un espace (42) adjacent à la rotule (22), et dans lequel un lubrifiant est disposé dans l'espace (42).

9. Lien d'articulation à rotule (10) selon l'une quelconque des revendications 6 à 8, dans lequel le bouchon (36) est sensiblement complètement enfoncé dans le corps (12).

10. Lien d'articulation à rotule (10) selon la revendication 6, dans lequel le bouchon (36) définit un renfoncement pour recevoir la rotule, et dans lequel le renfoncement reçoit la rotule (22) dans un ajustage par pression qui retient le bouchon (36) sur la rotule (22).

11. Lien d'articulation à rotule (10) selon l'une quelconque des revendications précédentes, dans lequel le corps (12) est fixé sur un élément supplémentaire.

12. Lien d'articulation à rotule (10) selon la revendication 11, dans lequel l'élément supplémentaire comprend un goujon de rotule supplémentaire.

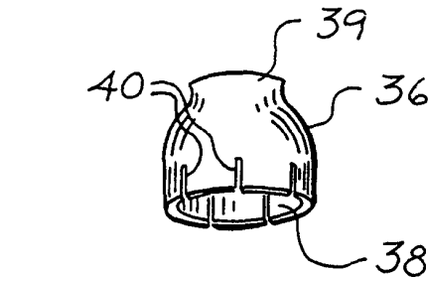

Fig. 6

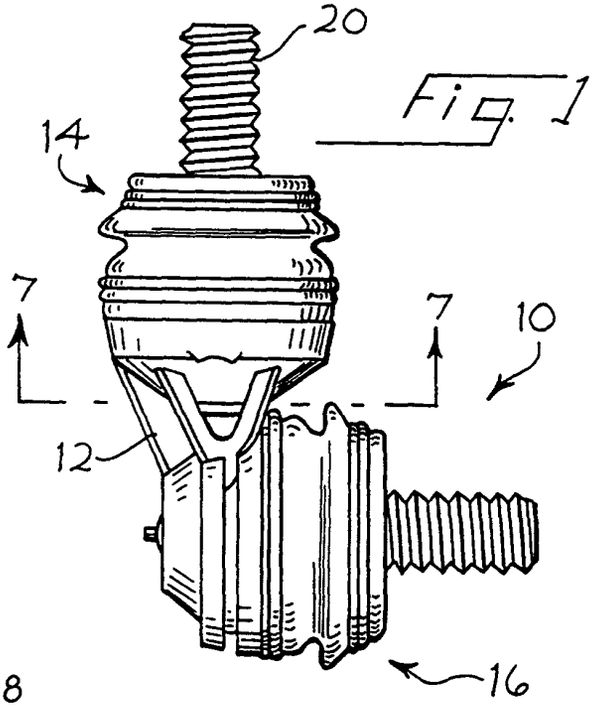

Fig. 1

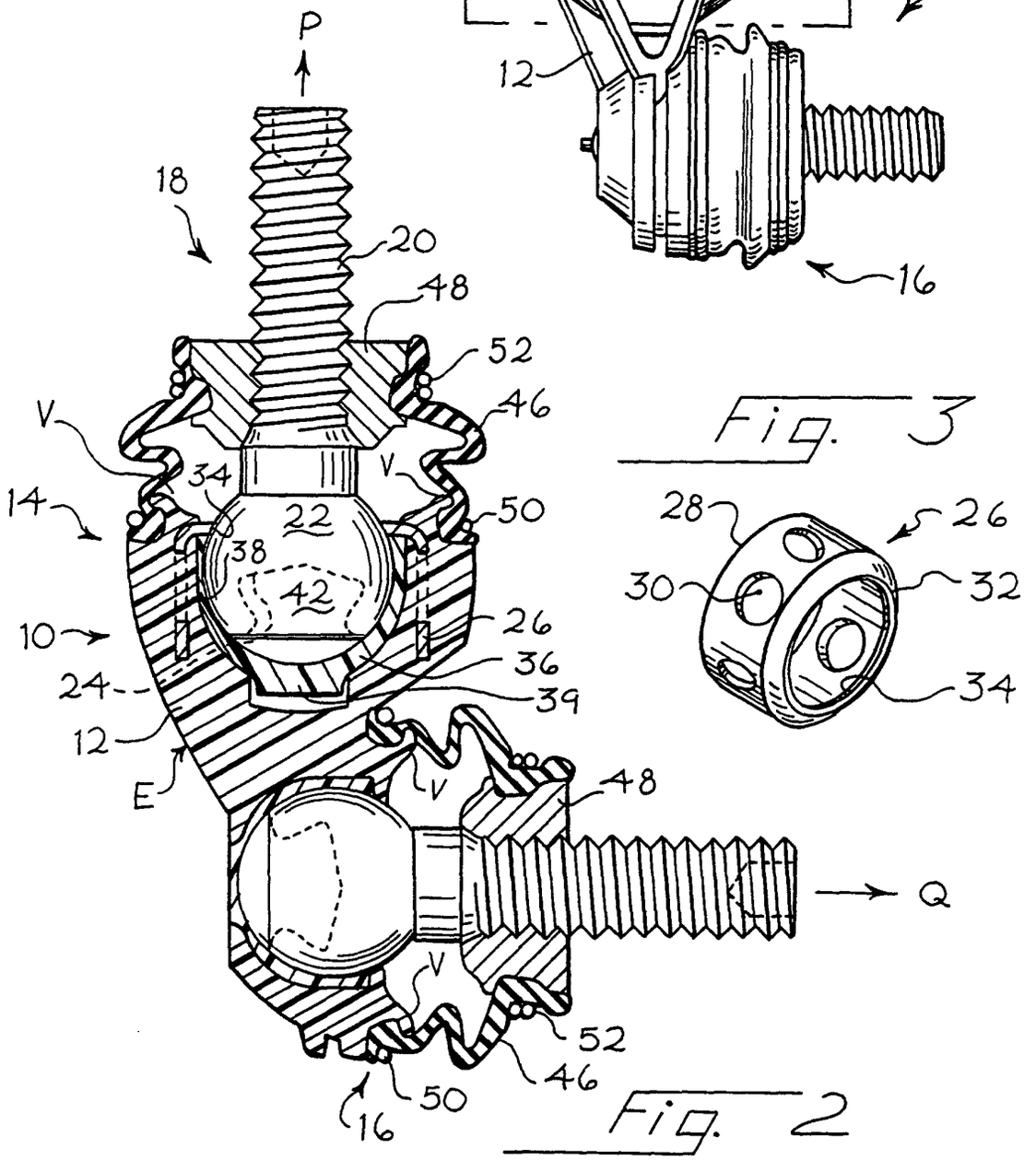

Fig. 2

Fig. 3

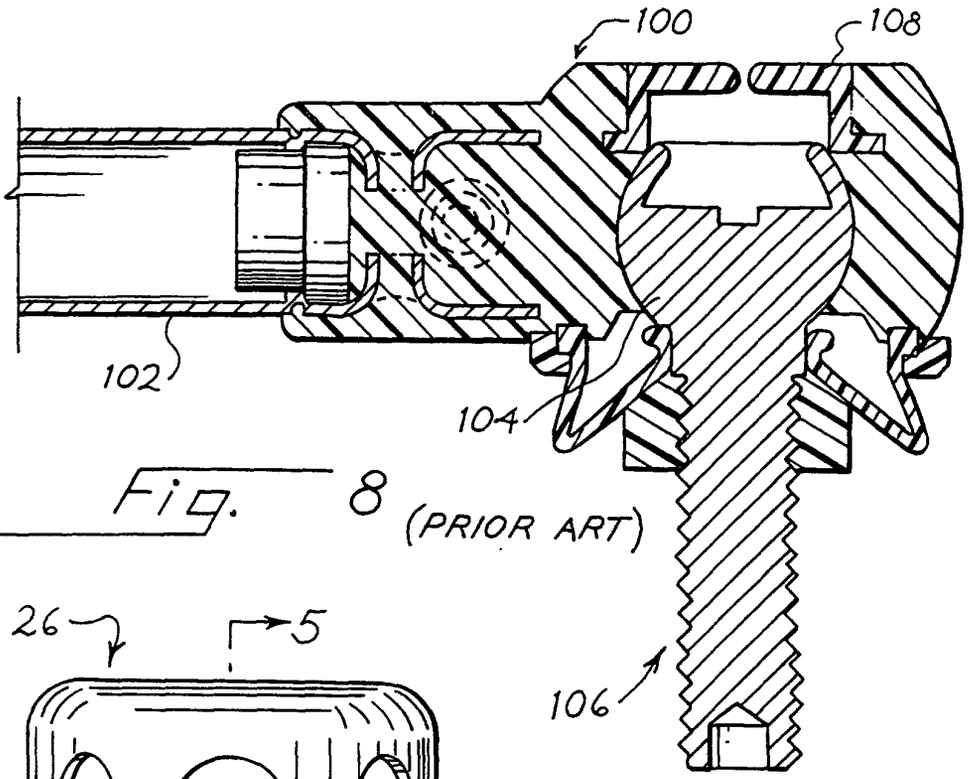

Fig. 8 (PRIOR ART)

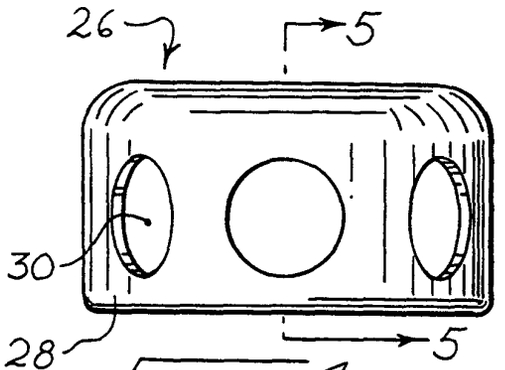

Fig. 4

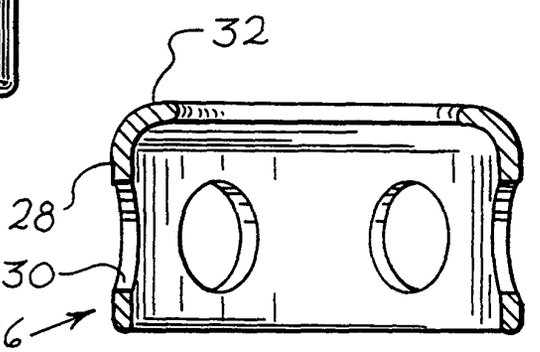

Fig. 5

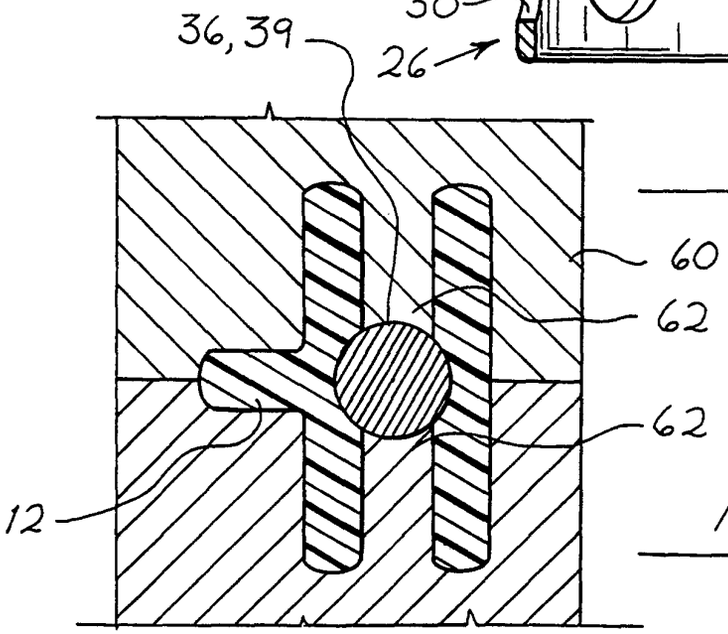

Fig. 7